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(54) Fluid level indicators

(57) A plurality of transparent slices 1 of part-elliptical section, Fig 2, are mounted together to form an elongate body 7, which is immersed in the fluid whose level 4 is to be measured. Each slice has an LED 5 and a photodiode 6 at the respective foci, direct light being screened off by stop 9. In slices below the surface, light is totally internally reflected to the detectors; for those above it escapes. Screening between slices may be provided. In another arrangement having higher resolution, thicker slices are used each having a plurality of sources and detectors side by side across the thickness of the slice. Sequential electrical scanning is used within each slice.

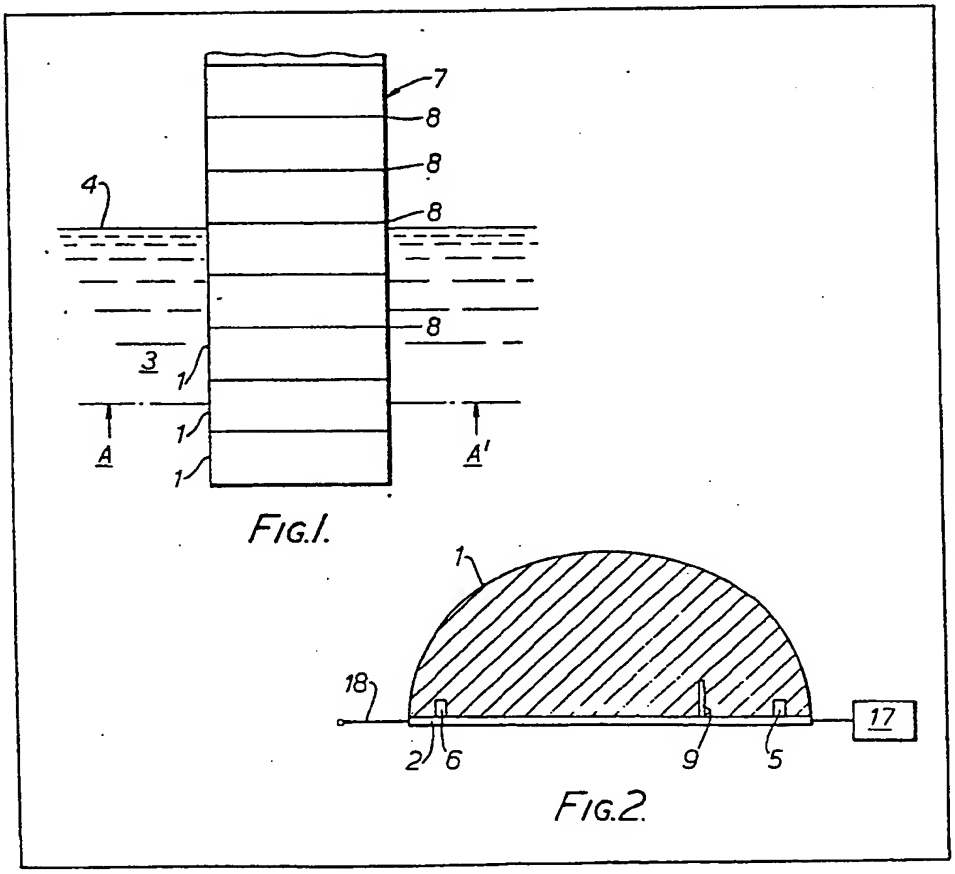

FIG.1.

FIG.2.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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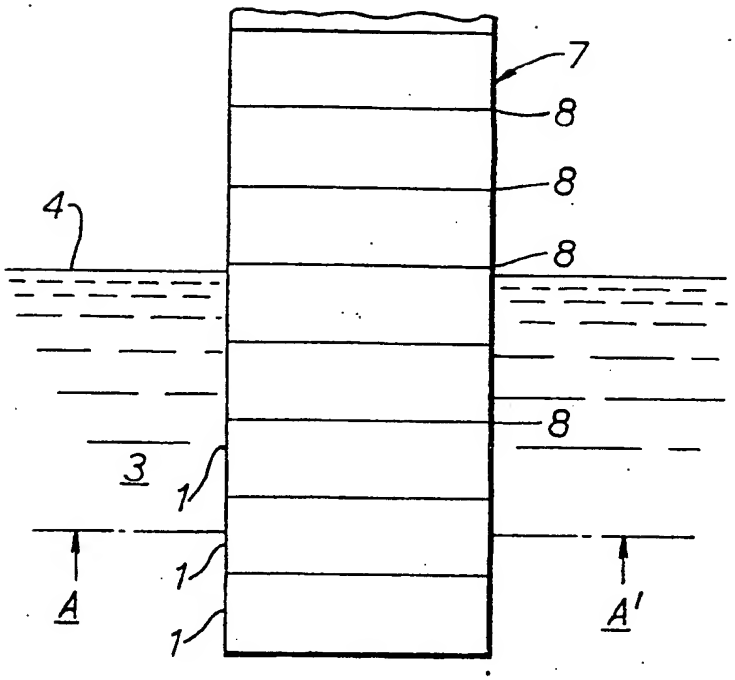

FIG.1.

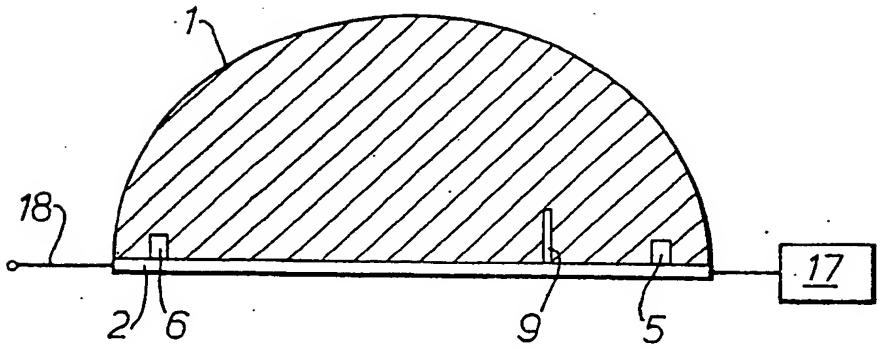

FIG.2.

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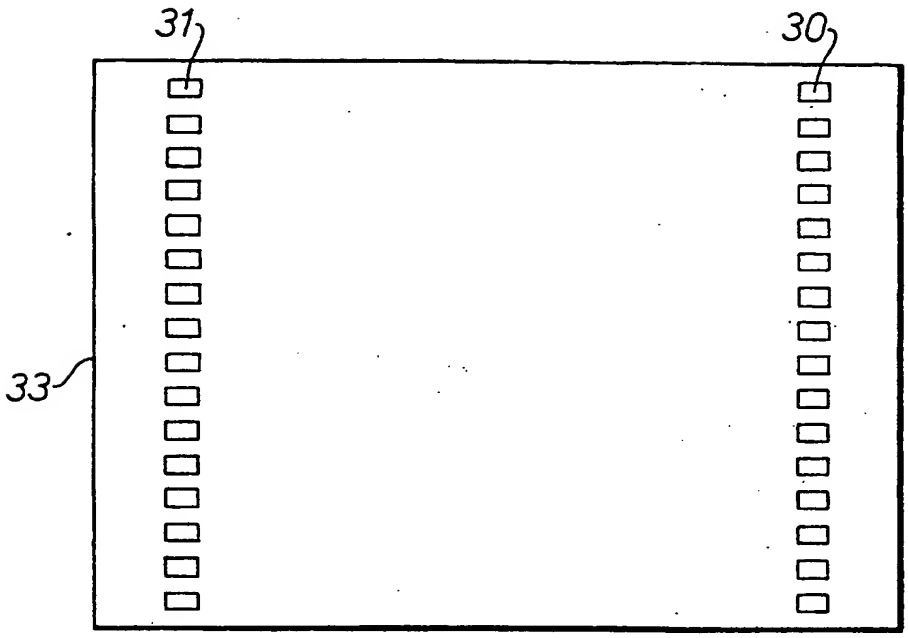

FIG. 3.

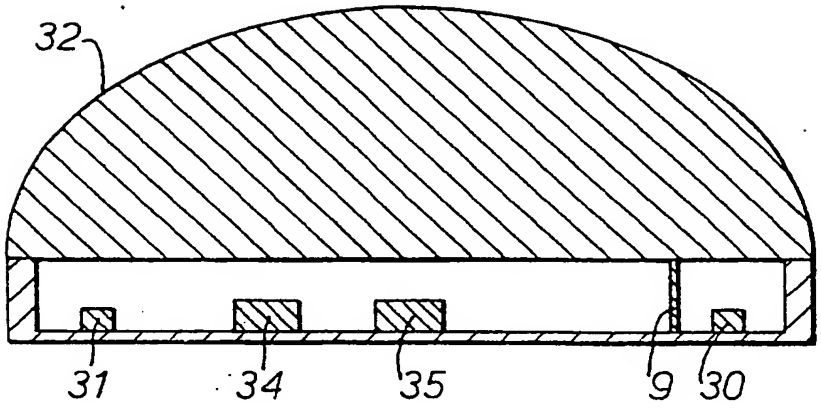

FIG. 4.

SPECIFICATION

Improvements in or relating t fluid level indicators

This invention relates to fluid level indicators, and seeks to provide an improved indicator which does not rely on the provision of moving parts to detect the position of the surface of a fluid in which the indicator is partially immersed.

According to this invention a fluid level indicator includes a transparent body having an outer surface formed from at least a portion of a prolate spheroid and having two foci, means located at one focus for illuminating part of the interior of said surface with electromagnetic radiation, and detection means arranged at the other focus to receive electromagnetic radiation total internally reflected from said part of surface whereby the intensity of the received radiation is indicative of whether said part of the surface which is illuminated is above or below the surface of a fluid in which the body is partially immersed.

Preferably the prolate spheroid is in the shape of part of an ellipse.

Preferably the means for illuminating part of the interior of said surface produces light and the means for detecting the electromagnetic radiation is a photo detection means.

Preferably again said transparent body is of elongate shape extending in the direction in which it is immersed in a fluid.

Preferably again a plurality of light emitting elements are positioned longitudinally along said elongate body so that each element illuminates primarily a different part of said body.

Preferably the light emitting elements are light emitting diodes.

Preferably again a plurality of photo detectors are positioned longitudinally along said elongate body so that each receives illumination primarily from a different part of said body.

The light emitting diodes and the photo detectors are provided in pairs, each pair being spaced from each other pair in a direction longitudinally along said elongate body. In order to prevent cross talk or interference between adjacent pairs they may be scanned sequentially in time. Alternatively each pair may be optically screened from adjacent pairs, in which case each pair is preferably located at a parallel sided slice of said elongated body, which is optically separated from adjacent slices by a layer of opaque material positioned on each of the opposing flat side faces.

The invention is further described by way of example with reference to the accompanying drawings in which,

Figure 1 shows a fluid level indicator in accordance with the present invention partially immersed in a fluid,

Figure 2 shows a section view of the fluid level indicator,

Figure 3 represents a modified fluid level indicator also in accordance with the present invention and which is capable of greater resolution

and Figure 4 shows a section view through the fluid level indicator of Figure 3.

The fluid level indicator shown in Figures 1 and 2 consists of a number of separate slices 1, which together form an elongate body 7. Each slice 1 is in the shape of a portion of an ellipse which is mounted on a printed circuit board 2 which is common to all slices, and which serves to electrically interconnect them. The fluid level indicator is immersed in a fluid 3 having a surface 4 located as shown. A light emitting diode 5 is provided at one of the foci of the ellipse and a photo diode 6 is provided at the other of the two foci. Both the light emitting diode 5 and the photo diode 6 are mounted in apertures in the flat bottom surface of the body 1. The light emitting diode 5 is connected to a d.c. power source 17 and the photo diode is connected to provide an output signal on line 18. The power source 17 is common to all slices 1, and the lines 18, one from each slice, are connected to a common indicating device (not shown). A light stop 9 is mounted on the printed circuit board 2 and its purpose is to prevent direct non reflected light emitted by the light emitting diode from reaching the photo diode 6. The elliptical portion of the body 1 is a portion of a body which is dimensioned in accordance with the equation

$$\frac{b}{a} = \sqrt{1 - \left(\frac{n_{max}}{n_o}\right)^2}$$

where a is the semi-major axis dimension of the ellipse, b is the semi-minor axis,

n_{max} is the maximum refractory index of the fluid in which the level indicating device is to be inserted and n_o is the refractory index of the body 1.

In operation, the body is immersed into the fluid 3 and the surface level 4 can be detected as the total internal reflection of light within the body 1 is dependent on the depth of immersion. For total internal reflection the reflective index n of the fluid must be less than the reflective index n_o of the material of which the body 1 is formed.

For slices 1 below the surface 4, light is reflected by the curved surface to the photo diode 6, but for slices above the surface light escapes into the atmosphere and is not detected.

Thus the nature of the output of the photo detectors 6 indicates where that particular slice 1 of the body 7 on which the light emitting diode 5 and the photo diode 6 pair is above or below the surface 4. The resolution of the fluid level indicator shown in Figures 1 and 2 is determined by the thickness of each slice and the resolution of a device constructed in this way may be quite adequate for many applications. To prevent interference between adjacent slices a thin layer 8 of opaque material is positioned on the flat side faces as shown.

However, where greater resolution is required a level indicator of the form shown in Figures 3 and 4 may be utilised in which a plurality of light

emitting diodes 30 and photo diodes 31 are mounted within a single thick slice 33 of a transparent body having a surface 32 in the shape of part of an ellipse, as previously. As before the light emitting diodes and the photo diodes are positioned at respective foci of the ellipse. The photo diodes and the light emitting diodes are scanned sequentially in time so that at any instant only one pair is activated. In this way cross talk between adjacent light emitting diodes or photo diodes is avoided. The resolution obtainable in this way is great and is limited only by the physical spacing of the light emitting diode — photo diode pairs from one another. Typically the spacing could be about .005". In order to increase the length of a fluid level detector so as to accommodate great variations in the depth of a fluid, a number of sections shown in Figure 3 can be connected end to end to make a very long elongate body. In this case control devices 34, 35 are mounted on each slice to control the scanning of each light emitting diode — photo diode pair and to pass the output to adjacent slices. An opaque layer can be inserted between adjacent sections so that the light emitting diodes and the photo diodes within each section can be scanned simultaneously.

CLAIMS

1. A fluid level indicator including a transparent body having an outer surface formed from at least a portion of a prolate spheroid and having two foci, means located at one focus for illuminating part of the interior of said surface with electromagnetic radiation, and detection means arranged at the other focus to receive electromagnetic radiation total internally reflected from said part of surface whereby the intensity of the received radiation is indicative of whether said part of the surface which is illuminated is above or below the surface of a fluid in which the body is partially immersed.

2. An indicator as claimed in claim 1 and wherein the prolate spheroid is in the shape of part of an ellipse.

3. An indicator as claimed in claim 1 or 2 and wherein the means for illuminating part of the interior of said surface produces light and the means for detecting the electromagnetic radiation is a photo detection means.

4. An indicator as claimed in claim 1, 2 or 3 and wherein said transparent body is of elongate shape extending in the direction in which it is immersed in a fluid.

5. An indicator as claimed in claim 4 and wherein a plurality of light emitting elements are positioned longitudinally along said elongate body so that each element illuminates primarily a different part of said body.

6. An indicator as claimed in claim 5 and wherein the light emitting elements are light emitting diodes.

7. An indicator as claimed in claim 4 and wherein a plurality of photo detectors are positioned longitudinally along said elongate body so that each receives illumination primarily from a different part of said body.

8. An indicator as claimed in claims 5 and 7 and wherein the light emitting diodes and the photo detectors are provided in pairs, each pair being spaced from each other pair in a direction longitudinally along said elongate body.

9. An indicator as claimed in claim 8 and wherein the pairs of light emitting diodes and photo detectors are scanned sequentially in time.

10. An indicator as claimed in claim 8 and wherein each pair of light emitting diode and photo detector is optically screened from adjacent pairs.

11. An indicator as claimed in claim 10 and wherein each pair is located at a parallel sided slice of said elongated body, which is optically separated from adjacent slices by a layer of opaque material positioned on each of the opposing flat side faces.

12. A fluid level indicator substantially as illustrated in and described with reference to Figures 1 and 2 or Figures 3 and 4 of the accompanying drawings.

New claims or amendments to claims filed on 5th July 1979

Superseded claims 1, 4, 5, 6, 7, 8, 9, 10

New or amended claims:—

1. A fluid level indicator including a transparent body extending in the direction in which it is immersed in a fluid with the body having an outer surfaced formed from at least a portion of a prolate spheroid and having two foci; means located at one focus for illuminating part of the interior of said surface with electromagnetic radiation; and a plurality of detection means arranged at the other focus and spaced longitudinally along said body to receive electromagnetic radiation totally internally reflected from said part of surface whereby the intensity of the radiation received by a detector is indicative of whether that part of the surface from which reflected radiation is received is above or below the surface of the fluid in which the body is partially immersed.

4. An indicator as claimed in any of the preceding claims and wherein a plurality of light emitting elements are positioned longitudinally along said elongate body so that each element illuminates primarily a different part of said body.

5. An indicator as claimed in claim 4 and wherein the light emitting elements are light emitting diodes.

6. An indicator as claimed in claim 5 and wherein the light emitting diodes and the photo detectors are provided in pairs, each pair being spaced from ach other pair in a direction longitudinally along said elongate body.

7. An indicator as claimed in claim 6 and wherein the pairs of light emitting diodes and photo detectors are scanned sequentially in time.

8. An indicator as claimed in claim 6 and wherein each pair of light emitting diode and

photo detector is optically screened from adjac nt pairs.

9. An indicator as claimed in claim 8 and wherein each pair is located at a parallel sided slice of said elongated body, which is optically separated from adjacent slices by a layer of opaque material positioned on ach of the opposing flat side faces.

10. A fluid level indicator substantially as illustrated in and described with reference to Figures 1 and 2 or Figures 3 and 4 of the accompanying drawings.

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